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Forest Pest Management Report

R-3 87-2

BIOLOGICAL EVALUATION
Effects of Soil Fumigation on
Soilborne Plant Pathogens and Seedlings
at the Albuquerque Tree Nursery

Cibola National Forest
New Mexico
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USDA Forest Service, Southwestern Region
State and Private Forestry
Forest Pest Management
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Albuquerque, New Mexico 87102

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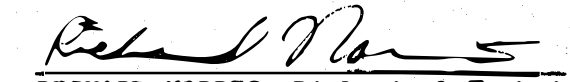

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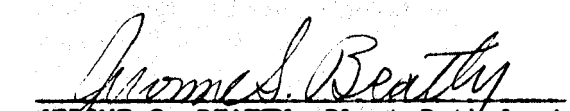

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SUMMARY

The Albuquerque Tree Nursery (ATN) annually fumigates seedbeds with methyl bromide and chloropicrin at an average rate of 350 pounds per acre for the purpose of suppressing potential soilborne plant pathogens, weeds, and nematodes. Since 1979, Forest Pest Management has evaluated the effectiveness of the annual fumigation in reducing population levels of various species of Fusarium and Pythium.

Block 1 was fumigated during the week of June 30, 1986, using the alternate strip method. Prefumigation Fusarium spp. population levels averaged 3,618 propagules per gram (ppg) in Block 1. Fusarium levels were reduced significantly after fumigation, down to 32 ppg. Pythium spp. population levels were low before fumigation (10 ppg) and were reduced to 0 ppg (Table 1). Seedling survival was lower in the unfumigated plots than in the fumigated areas (Table 2).

Table 3 illustrates the pre and postfumigation population levels of Fusarium spp. and Pythium spp. from 1979 through 1986.

METHODS

Prefumigation soil sampling was conducted in Block 1 on June 17, 1986, specifically to assay species of Fusarim and Pythium. Sections 7 through 12 and 16 of Block 1, were sampled by walking the length of each section and inserting a soil core extractor 4 to 6 inches into the soil at 20-foot intervals. Collected soil cores were mixed and each was placed in a separate bag labeled with the appropriate section number and collection date. Fusarium and Pythium spp. isolations were performed using standard soil dilution plating techniques and selective media for Fusarium and Pythium spp. adopted by the Reforestation Improvement Program Committee. Postfumigation soil sampling was conducted on July 7, 1986, and end-of-season soil sampling was conducted on September 4, 1986, in Block 1 using the same techniques.

Fumigation effects on seedling survival were determined by establishing two unfumigated plots in Block 1. In the selected sections (Sections 9 and 11), the fumigation crew was instructed to establish plots, each 16 feet by 24 feet. The unfumigated plot in Section 9 was located on the south edge of the section and the unfumigated plot in Section 11 was located at the north edge. Corners of the unfumigated plots were marked with flagging. Areas immediately adjacent to the unfumigated plots served as fumigated plots.

Seedling density estimates, comparing fumigated with unfumigated areas, were made by placing a 1- by 4-foot frame across each bed in the selected sections, and counting the live seedlings contained therein. Estimates were made on August 11, 1986, at the beginning of the growing season, and on September 29, 1986, at the end of the growing season.

RESULTS AND DISCUSSION

Prefumigation soil sampling in Block 1 showed that levels of Fusarium averaged 3,618 ppg. Block 1 was fumigated during the week of June 30, and postfumigation soil sampling indicated that the Fusarium population level was significantly reduced (32 ppg). Propagule density by the end of the growing season averaged 43 ppg (Table 1 and Figure 1).

Pythium spp. populations were found to be at a low level before fumigation (10 ppg) in Block 1 and were reduced to 0 ppg. At the end of the growing season, Pythium population levels averaged 2 ppg (Table 1 and Figure 1).

Block 1 was sown to provide 40 viable seedlings per square foot. Seedling density was higher in fumigated soils than in unfumigated soils. Unfumigated soils yielded 32 seedlings per square foot on August 11, 1986, as opposed to 41 seedlings per square foot in fumigated soils. On September 29, 1986, seedling counts were 29 in unfumigated soils and 37 in fumigated soils in Block 1 (Table 2, Figure 2).

CONCLUSIONS AND RECOMMENDATIONS

The benefits gained from fumigation of Block 1, namely the reduction of Fusarium population levels and the higher seedling survival rate, more than justify the expense of fumigation (refer to Biological Evaluation R-3 83-10) and seedbed fumigation should continue at the present levels.

TABLE 1.--Means and standard errors of Fusarium and Pythium populations (Block 1, Sections 7 through 12 and 16).

	Fusarium spp.		Pythium spp.	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Prefumigation	3,618	357	10	5
Postfumigation	32	32	0	0
End of Season	43	32	2	2

TABLE 2.--Means and standard errors of seedling densities (trees per square foot) (Block 1, Sections 9 and 11).

		$\bar{x}$	$s_{\bar{x}}$
August	Unfumigated	32	0.55
	Fumigated	41	1.91
September	Unfumigated	29	2.07
	Fumigated	37	4.18

TABLE 3.--Pre and postfumigation population levels of Fusarium and Pythium (1979-85) (propagules per gram).

		Pre	Post
1979			
Block 3	Fusarium	20,190	9,328
	Pythium	8	5
Block 4	Fusarium	6,162	10,060
	Pythium	13	6
1980			
Blocks 3 & 4	Fusarium	4,240	1,829
	Pythium	12	1
1981			
Block 1	Fusarium	1,543	53.33
	Pythium	6	1
1982			
Block 7	Fusarium	2,698	149
	Pythium	2	1
Block 8	Fusarium	1,584	47
	Pythium	3	1

Table 3. Continued

1983			
Block 5	Fusarium	2,952	66.67
	Pythium	2	0
Block 1	Fusarium	6,033	133
	Pythium	--	--
1984		Pre	Post
Block 8	Fusarium	400	111
	Pythium	4	1
Blocks 1 & 2	Fusarium	4,633	33
	Pythium	1	0
1985			
Block 7	Fusarium	6,000	27
	Pythium	1	0
Block 8	Fusarium	3,500	0
	Pythium	0	0
1986			
Block 1	Fusarium	3,618	32
	Pythium	10	0

Figure 1. MEAN POPULATIONS OF FUSARIUM & PYTHIUM AT THE ALBUQUERQUE TREE NURSERY

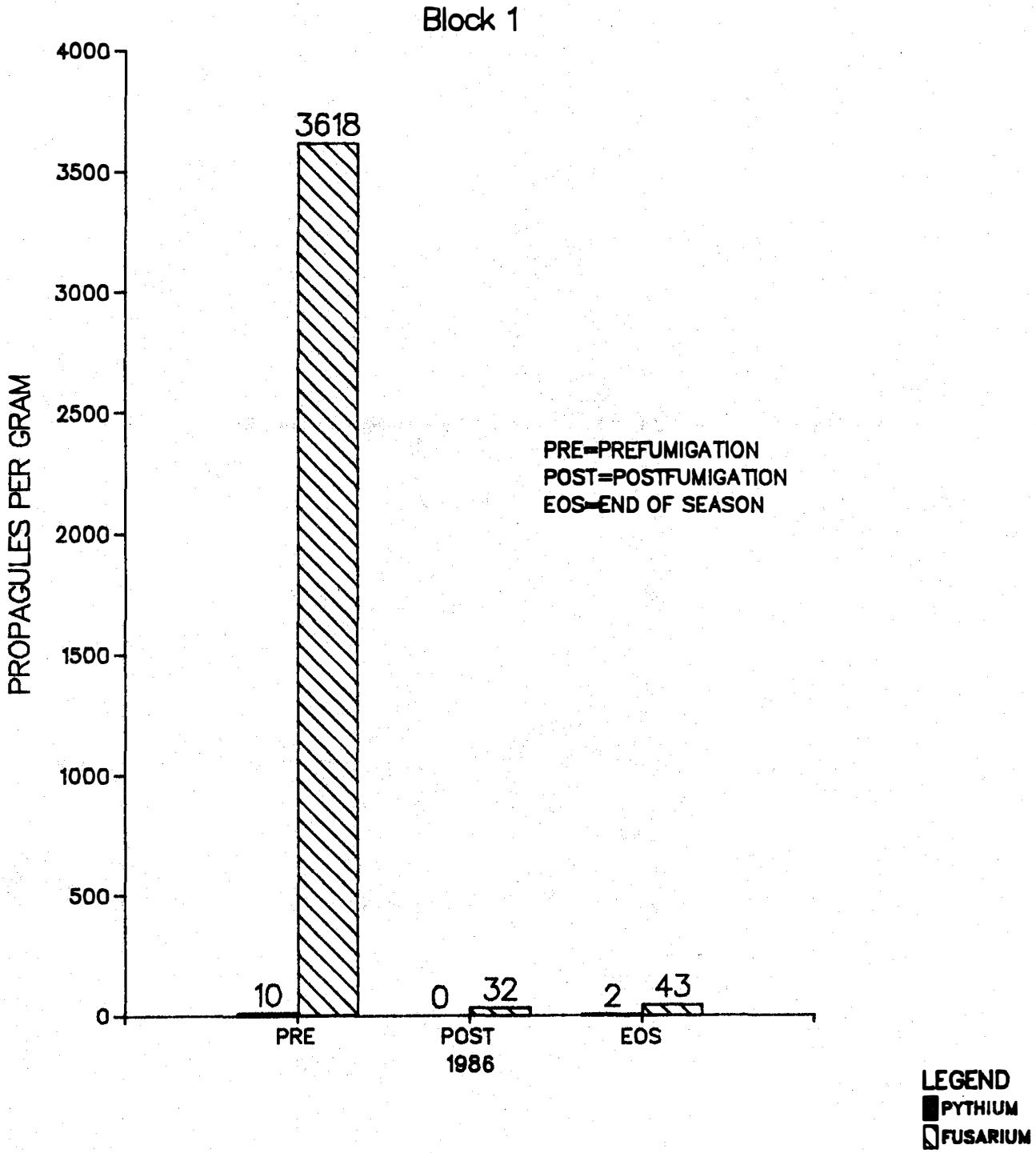

Figure 2. MEAN TREE DENSITIES
AT THE ALBUQUERQUE TREE NURSERY